

**What is claimed is:**

- 1           1.     A method for prestaging data in a storage system having a cache, the  
2     method comprising the steps of:  
3           determining a relative change in the frequency of data access for a storage  
4     region in the system;  
5           determining a relative change in the effectiveness of previous prestage  
6     operations; and  
7           determining whether to prestage data in the cache and the amount of data to  
8     prestage based on the determined relative change in access frequency, the  
9     determined relative change in the effectiveness and the size of last I/O access.
  
- 1           2.     The method as recited in claim 1, wherein the step of determining a  
2     relative change in the frequency of data access includes the steps of:  
3           maintaining statistics on data access to the region in a store, said statistics  
4     including data location, I/O size and access frequency; and  
5           comparing the statistics of recent I/O requests to the maintained statistics to  
6     determine the relative change in access frequency for the region.

1           3.     The method as recited in claim 1, wherein the step of determining a  
2     relative change in the effectiveness of previous prestage operations comprises the  
3     steps of:

4                 recording the number of previous prestaging operations of data for the  
5     region;

6                 recording the number of I/O requests for data that has been prestaged for  
7     the region; and

8                 determining the relative change in the effectiveness by dividing the number  
9     of I/O requests for previously prestaged data in a region during a time period by the  
10    number of previous prestage operations for the region during the same time.

1           4.     The method as recited in claim 1, wherein if the relative change in the  
2     frequency of data access and the relative change in the effectiveness are both  
3     increasing, then data for the region is prestaged aggressively.

1           5.     The method as recited in claim 1, wherein if the relative change in the  
2     frequency of data access is increasing and the relative change in the effectiveness  
3     is decreasing, then data for the region is prestaged moderately.

1           6.     The method as recited in claim 1, wherein if the relative change in the  
2     frequency of data access is decreasing and the relative change in the effectiveness  
3     is increasing, then data for the region is prestaged moderately.

1           7.     The method as recited in claim 1, wherein if the relative change in the  
2     frequency of data access and the relative change in the effectiveness are both  
3     decreasing, then data for the region is prestaged minimally.

1           8.     A computer-program product for use with a storage system for  
2     prestaging data in the system, the computer-program product comprising:  
3         a computer-readable medium;  
4         means, provided on the computer-readable medium, for determining a  
5     relative change in the frequency of data access for a storage region in the system;  
6         means, provided on the computer-readable medium, for determining a  
7     relative change in the effectiveness of previous prestage operations; and  
8         means, provided on the computer-readable medium, for determining whether  
9     to prestage data in the cache and the amount of data to prestage based on the  
10    determined relative change in access frequency, the determined relative change in  
11    the effectiveness and the size of last I/O access.

1           9.     The computer-program product as recited in claim 8, wherein the  
2     means for determining a relative change in the frequency of data access includes:  
3           means, provided on the computer-readable medium, for maintaining  
4     statistics on data access to the region in a store, said statistics including data  
5     location, I/O size and access frequency; and  
6           means, provided on the computer-readable medium, for comparing the  
7     statistics of recent I/O requests to the maintained statistics to determine the relative  
8     change in access frequency for the region.

1           10. The computer-program product as recited in claim 8, wherein the  
2 means for determining a relative change in the effectiveness of previous prestage  
3 operations comprises:

4           means, provided on the computer-readable medium, for recording the  
5 number of previous prestaging operations of data for the region;

6           means, provided on the computer-readable medium, for recording the  
7 number of I/O requests for data that has been prestaged for the region; and

8           means, provided on the computer-readable medium, for determining the  
9 relative change in the effectiveness by dividing the number of I/O requests for  
10 previously prestaged data in a region during a time period by the number of  
11 previous prestage operations for the region during the same time.

1           11. The computer-program product as recited in claim 8, wherein if the  
2 relative change in the frequency of data access and the relative change in the  
3 effectiveness are both increasing, then data for the region is prestaged  
4 aggressively.

1           12. The computer-program product as recited in claim 8, wherein if the  
2 relative change in the frequency of data access is increasing and the relative  
3 change in the effectiveness is decreasing, then data for the region is prestaged  
4 moderately.

1           13. The computer-program product as recited in claim 8, wherein if the  
2 relative change in the frequency of data access is decreasing and the relative  
3 change in the effectiveness is increasing, then data for the region is prestaged  
4 moderately.

1           14. The computer-program product as recited in claim 8, wherein if the  
2 relative change in the frequency of data access and the relative change in the  
3 effectiveness are both decreasing, then data for the region is prestaged minimally.

1           15. A storage system comprising:  
2 a cache for prestaging data;  
3 means for determining a relative change in the frequency of data access for  
4 a storage region in the system;  
5 means for determining a relative change in the effectiveness of previous  
6 prestage operations; and  
7 means for determining whether to prestage data in the cache and the  
8 amount of data to prestage based on the determined relative change in access  
9 frequency, the determined relative change in the effectiveness and the size of last  
10 I/O access.

1           16.    The system as recited in claim 15, wherein the means determining a  
2   relative change in the frequency of data access comprises:  
3           means for maintaining statistics on data access to the region in a store, said  
4   statistics including data location, I/O size and access frequency; and  
5           means for comparing the statistics of recent I/O requests to the maintained  
6   statistics to determine the relative change in access frequency for the region.

1           17. The system as recited in claim 15, wherein the means for determining  
2 a relative change in the effectiveness of previous prestage operations comprises:  
3           means for recording the number of previous prestaging operations of data  
4 for the region;  
5           means for recording the number of I/O requests for data that has been  
6 prestaged for the region; and  
7           means for determining the relative change in the effectiveness by dividing  
8 the number of I/O requests for previously prestaged data in a region during a time  
9 period by the number of previous prestage operations for the region during the  
10 same time.

1           18. The system as recited in claim 1, wherein if the relative change in the  
2 frequency of data access and the relative change in the effectiveness are both  
3 increasing, then data for the region is prestaged aggressively.

1           19. The system as recited in claim 15, wherein if the relative change in  
2 the frequency of data access is increasing and the relative change in the  
3 effectiveness is decreasing, then data for the region is prestaged moderately.

1           20. The system as recited in claim 15, wherein if the relative change in  
2 the frequency of data access is decreasing and the relative change in the  
3 effectiveness is increasing, then data for the region is prestaged moderately.



1           21.    The system as recited in claim 15, wherein if the relative change in  
2   the frequency of data access and the relative change in the effectiveness are both  
3   decreasing, then data for the region is prestaged minimally.